

SOME RAKE-LEGGED MITES OF THE FAMILY CHEYLETIDÆ

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The genus *Cæculus* has been characterized as a very variable species. My studies convince me that although there is a small amount of variation in the number of bristles found in certain places, the species are definite and constant in their many characters. It is necessary however, to study more than one individual of the same stage of development carefully and in a detailed manner. In order to facilitate such study it is advisable to detach the legs and palp of one side (of both if the animal has not been killed in boiling water so as to cause the legs to spread). This is easily done by poking the posterior face of the coxa with a needle. Furthermore, I find that detailed figures are essential, many of the early figures being inadequate to certain reidentification.

As the body is not easily dehydrated, a pin prick (with finest minuten nadeln) to one side of the genital aperture is advisable before placing in absolute alcohol (for balsam mounts). As the bristles do not always dehydrate, it is better to study specimens by direct as well as indirect illumination.

In all my papers, lots without record of collector are understood to be mine.

Subfamily CÆCULINÆ

Mouth parts fixed, inconspicuous; mandibles small, with uncinate tip; palptarsus inserted on tibia ventroproximally; parasterna (epimera) not joined across thorax; leg segments with five longitudinal rows of bristles; genuals slightly shorter than tibiæ, femora and trochanters distinct, with articulation barely functional, the two segments subequal to genuals in length; mesal and ventral face of legs I each with a row of long spines; adults usually over one millimeter long, brown to black, heavily sclerotized.

Type: *Cæculus* (1).

As a rule nymphs are relatively shorter and broader than the adults, with greater space between mesal ends of parasterna (epimera). The number of bristles along anterior edge of parasterna I as well as the number of spines of legs I may be lower. The number of bristles on genital covers is the most reliable index of stage of development, being one, two, three for the three nymphal stages and six to eight for the adult.

Genus CÆCULUS (1)

Dorsal plates distinct, separated by thin often wrinkled skin, to more or less fused; cephalic plate broad enough to cover palps, produced anteriorly to roof over the mouth parts; dorsal bristles very small, usually spatulate.

Type: *Caeculus echinipes* (1).

Concerning *Caeculus echinipes* (1)

Three specimens from the Pic du Midi de Bigorre, Pyrenees, France, appear to belong to *C. echinipes* described from the arid hills of Moxente, southern Spain. The original description and figures are so crude as to make positive reidentification except of material from the type locality impossible.

In the genotype the cephalic shield extends posteriad to transverse plane of legs IV. The Florentine *C. echinipes* (5) has a much shorter cephalic plate. In the Pyrenees specimens the plate is of intermediate length. The genotype is figured as having long bristles springing from anterior edge of cephalic plate; Berlese figures them shorter. In my specimens they are still shorter and vary in number, as do the ridges on the plate (none to six, even differing on the two sides). Dufour figured no bristles on dorsum or posterior rim of abdomen (dorsal aspect). Berlese figured none on contour of abdomen but does indicate some of them on the dorsal shields, though they are so smeared over with coloring matter as to be barely distinguishable. I have figured all those discernible on the Pyrenees specimens. These bristles do not seem constant in position at different degrees of inclination of their plate. The transverse plates have three bristles (four if the plate is unusually long). The number on the abdominal plates varies still more (four to six). The skin between the plates is finely wrinkled and capable of much extension (omitted in fig-

ures). It must be said for Dufour that these bristles are very minute and that those of the posterior end of the abdomen vary in position according to the expansion or shrinkage of the abdomen, so that they are not always visible on the dorsal outline.

As to armature of legs I, the coxæ are consistently figured as bearing a short, curved, spatulate bristle on mesal face. Dufour figures the trochanter and femur as fused. Berlese figures these as fused on the left side only. I believe they are normally always distinct but often appear united. Neither of them figure a short spine on proximal end of the tibiæ (mesal face). Dufour figures long bristles on lateral face of legs I. These are really ventral and only visible when the leg is twisted from the normal position.

The figure of Canestrini and Fanzago (4) from the Trentino has all the appearance of being made by direct illumination, so that they miss the edges of the plates, but I cannot reconcile the two rectangular, nested platters figured by them with the system of plates as we know them. Furthermore they figure two bristles each side on posterolateral angles of the cephalic plate!, three tarsal hooks, two long rostral bristles, lateral plate bristles on rim of the inner platter, six on its posterior edge, and six more on posterior edge of outer platter. Of the long anterior bristles one pair may be the pseudostigmatic organs, but the other cannot be reconciled with either the Florentine species or with the specimens before me. Berlese figures five bristles on each lateral plate and two on each transverse.

The species of Karpelles (7) with its one long claw, exposed palps (short cephalic plate), rows of bristles on dorsum, cluster of bristles on posterior edge of abdomen (like *C. spatulifer* (6)), and the barely tapering bristles of legs I, from Fiume, Italy, is still more phenomenal or extremely crude. I do not think it belongs to the above group of forms at all.

Thus I am of the opinion that we have before us four distinct species or subspecies, each confined to its own mountain massif, and I would designate that from the Pyrenees as:

***Cæculus echinipes crosbyi* subsp. nov.**

(Figures 1-8)

Diagnostic characters: Bristles of anterior edge of cephalic plate small, inconspicuous; cephalic plate extending posteriad to transverse plane passing

between legs II and III; mesal bristle of coxæ I serrate edged (figure 3); major segment (femur) of palp with two fairly long, ciliate bristles, genual with a longer ciliate bristle (thus differing markedly from the figure given (5, fasc. 73/7); palptibiæ with four bristles: a dorsal and a lateral, barbed, and two smooth mesal, the proximal one with swollen distal end, the proximal pointed; terminal bristle clawlike, strong, with swollen distal end; palptarsus with at least five fine bristles at distal end.

Description: Cephalic plate wrinkled, the number of wrinkles not constant or equal on the two sides but about five per side (figure 1), peripheral bristles small, spatulate, ribbed, barbed (figure 2), one to three each side, a pale, more or less colorless area at base, three bristle insertions on each side at widest part; eyes contiguous; median plate roughly rectangular, more or less sculptured with weakly developed vermiculations, with three pairs of insertions: one on anterior edge, another near middle, the other near posterior edge; lateral plate three lobed, extending nearly to eyes, with eight insertions, the distal three nearly in line, the middle three strongly offset, the posterior two on posterior half of posterior lobe, these three groups separated by short pseudofissuræ; posterior plates somewhat oval, with three insertions; these plates, in one specimen are extended mesad and bear a fourth insertion (indicated by dotted lines in figure 1); abdominal plates irregular and inconstant in shape, bearing from four to seven insertions as indicated in figure 1 which is a composite study; other insertions in the thin skin (as indicated in figure 1) vary in position according to degree of extension or shrinkage of body. All these insertions bear small, spatulate, serrate-edged bristles.

Labium, in ventral aspect, with a single pair of insertions; parasterna (epimera) I each with seven slightly clavate bristles, along anterior and mesal edge progressively longer laterad, the lateral as long as width of coxæ; parasterna II each with two insertions near anterior edge; parasterna III narrowly separated from parasterna II, each with three widely spaced insertions near anterior edge; parasterna IV each with three insertions extending diagonally across their plate; genital covers very slender, each with eight insertions on mesal edge; agenital covers angularly semioval, each with three insertions, anal covers slender, each with two insertions; paranal covers crescentic, each with three insertions one of which is on posterior end; posterior end of abdomen emarginate.

Palps as above described. Tarsus less gibbous than figured by Berlese (5, fasc. 73/7), strongly transversely wrinkled, the bristles as in figure 6, depending on orientation and angle of inclination.

Legs I (figure 4, in which, as usual in this genus, the tarsus is foreshortened) with equal unguis (hooks); tarsi I and II with five pairs of short spatulate bristles on dorsal face, four pairs of stout, pointed bristles on ventral face, distal end with a pair of short, pointed bristles on ventral face, another pair, slightly longer on sides, a long, slender, dorsomedian, and a more proximal, spatulate dorsomedian; other segments with five longitudinal rows of bristles: a mesal row of spines, a ventral row of spines, and three dorsal and lateral rows of short, spatulate bristles. Other odd bristles occa-

sionally occur between these rows. The spatulate bristles may be replaced by fine, short, straight bristles; spinelike bristles usually mounted on cylindrical apophyses; tibiae with three subequal, spinelike bristles and a short fine one on mesal face; genuals with three spinelike bristles on mesal face, these bristles progressively longer distad; trochanters and femora each with a long spinelike bristle on mesal face, slightly swollen at distal end; coxæ short-cylindrical, mesal bristle on an apophysis nearly as long as the bristle.

Legs II similar but coxæ longer; trochanters also longer, with three spine-like bristles, the middle one the longest, distal one the shortest; femora short, without spinelike bristles; genuals with two mesal spinelike bristles, the proximal much the longer, ventral face with three medium-long, spinelike bristles, the proximal the shortest; tibiae with mesal and ventral bristles rather short, subequal, five in each row; tarsi quite like tarsi I.

Legs III and IV not specifically differentiated; body of tarsi III (figure 7) and IV with five pairs of spatulate and five pairs of pointed bristles, long dorsodistal bristle much longer, inserted more proximad; genuals, femora and trochanters with spatulate bristles only; coxæ III with three spatulate bristles on lateral face (figure 8), coxæ IV without.

Cotypes: Three specimens from under face of stones, Pic du Midi de Bigore, Pyrenes, France; taken July 25, 1932, by Cyrus R. Crosby, slides 331a and -b.

***Cæculus laoshanensis* sp. nov.**

(Figures 15-18)

Diagnostic characters: Resembling *C. echinipes crosbyi* but each side of anterior rim of cephalic plate with a single, well-developed bristle inserted on a prominent anteriorly projecting ridge (figure 15); pseudostigmatic organs short, styliform, with slightly clavate head, obliquely truncate (figure 15); posterior plates of dorsal shield continuous, bearing 10-12 bristles; bristles of posterior edge of abdomen broader, veins more branched, teeth broader and smaller; only five bristles on parasterna I; parasterna III with lateral bristle absent or not discernible; agenital plates with but two bristles each; coxæ of legs I with two spatulate bristles on mesal face (figure 16); mesal spines of trochanter and femur equally developed; proximal bristle of genuals very small (figure 16); claws of legs I and II very unequal, of III and IV equal (figure 17).

Description: Rather than describe the form in detail, only the points of minor difference with *C. echinipes crosbyi* will be given. The bristle ridges of the cephalic plate give it a horned appearance; lateral bristles of hood inserted more posteriad, slightly posteriad of greatest width of hood; row of three posterior bristles more closely spaced, more distant from eyes; lateral plates with only seven bristles arranged 2:2:3 (with the colon standing for the pseudoforamen); bristles of dorsal shield and abdomen larger; mesal bristles of parasterna III and IV close to each other; entire animal broader; agenital and adanal plates smaller.

Nymphs I (figure 18) and II (with 1 and 3 bristles to each genital cover, respectively) with four bristles on parasterna I; tarsal claws as in adults except that legs III and IV have the outer nail (corresponding to the small nail of legs I and II) slightly weaker than the other; trochanters I with mesal spine short, clavate (figure 18); genuals I with but one long spine (and a short one).

Cotypes: Three adults, five nymphs from grass clump, dry, shady locality, Bai Djiou Shui Miao, Lao Shan Mts., Shantung, China; taken June 15, 1928, slides 2815 Caec. 1 and -2.

Cæculus sinensis sp. nov.

(Figures 23-28, 30-31)

Diagnostic characters: Bristles of dorsal aspect spatulate; dorsal plates considerably fused and indistinct, forming a dorsal shield; cephalic plate with anterior bristles minute, inserted on dorsal face of plate in the furrow which causes the emargination of the edge (figure 23); another pair of minute bristles on cephalic plate, inserted on transverse plane passing just posterior of the lateral bulge of cephalic plate; a bristle inserted anteromesad of eyes, distant from eyes slightly more than diameter of one of them (figure 23); area of median plate with three pairs of bristles, laterad of these pairs near lateral margin of dorsal shield a bristle (totaling three along each side); posterior edge of dorsal shield (area of transverse plates) with five bristles; posterior edge of abdomen with five bristles; parasterna I with six bristles inserted along anterior and mesal edges; genital covers with six bristles; labium (hypostome) with two pairs of bristles, their insertions quite evident in ventral aspects, a marked fenestration between apices of mandibles and maxillæ; pseudostigmatic organs slender, barely clavate.

Description: Cephalic plate, compared with *C. echinipes crosbyi* short, broad, with a well defined, broad emargination, forming a broad median lobe and two angular lateral lobes which are the apices of diverging ridges (figure 23). This species differs from several of the European (the *C. echinipes* group) by having the anterior bristles inserted in the groove instead of on the apex of the lateral lobes or ridges; occasionally two bristles may be seen closely crowded together in one groove, and one in the other; median plate only faintly sculptured; anterior pair of bristles of median plate more approximate than those of the other two pairs; an individual has the posterior bristle of the lateral plates replaced by two; bristles about posterior end of abdomen vary in exact position according to degree of inflation or wrinkling of abdomen, there are two pairs at lateral angles: one dorsal and one ventral, the ventral one being figured in the lower half of figure 23.

The pattern of the ventral aspect of the mouthparts with its four insertions and two fenestrations (forming six symmetrical light spots) is very characteristic (see also figure 29). The upper part of the camerostome projects as a distinct labrum with two or three median denticles (figure 31) and is overarched by the cephalic hood (plate). Parasterna with mesal edges

rather remote; parasterna II with three bristles fairly close to anterior edge; parasterna III with one bristle near center of anterior edge and one at mesal end; parasterna IV with three bristles along center of plate and one at posteromesal corner; minute bristles of ventral skin omitted.

Legs I and II with unequal ungues, the mesal being less than half length of lateral (figures 21 and 22), mounted on a distinct T-shaped unguitractor plate which articulates between two apophyses of the tarsal wall (figures 21 and 22, where these apophyses are black); tarsi I with only four bristles in longitudinal rows, no long dorsomedian bristle (figure 24); tibiae with three bluntly pointed spines on mesal face, the proximal being half length of the others, a medium long and a short bristle between the two longitudinal rows of spines (figure 24); genuals with two mesal spines, the proximal one clavate, half the length of the other; femora with one long, mesal, slightly clavate spine. Trochanters as femora; coxae with two short, clavate mesal bristles, the distal one the longer (figure 24); spines of ventral face similar to mesal face but no spine on femora or coxae.

Legs II similar but spines not so long, not developed on trochanters and femora, though trochanter has a rather long, clavate bristle on ventral face; genuals with a fairly long, clavate bristle on ventral and on mesal face.

Legs III and IV with equal claws. Tarsi with long dorsomedian bristle and four to five bristles in longitudinal rows. Other segments not conspicuously differentiated.

Nymphs: In dorsal aspect the nymphs are similar to the adults, but the body is shorter and broader. All nymphs have four bristles on each parasterna I (figures 30 and 31). The mesal bristle of parasterna II is inserted on juncture of parasterna I and II. In nymphs I parasterna IV are relatively much smaller than the other three and they seem to have one or two bristles less. In figure 30, the lower parasternum I is abnormal in that it has an extra bristle. Each genital cover has six bristles in nymphs III, three in nymphs II and one in nymphs I. The spines of legs I are similar in all nymphal stages except in the case of the genual, where the proximal spine seems more robust and longer in nymphs III than in some adults and is absent in nymphs I.

Cotypes: Three adults, five nymphs, from leaf mould, the repant *Selaginella mongolica*, and the fuzzy, dried up leaves of *Boea hygrometrica* from ravine of Chaoyang An, hills west of Peking, China; taken September 7, 9 and 19, 1921; slides 21124, 21126, 21171a.

Cæculus sinensis taishanicus subsp. nov.

(Figures 19-22, 29)

Differs from the species in that the cephalic plate has the anterior edge much more deeply emarginate, leaving a much narrower median lobe (figure 19); anterior bristles larger, projecting well beyond edge of plate, inserted

on conspicuous nubbins; pseudostigmatic organs stouter, not clavate, coarsely burred, blunt (figure 19); lateral bristles of cephalic plate larger, inserted nearer lateral edge of plate; in the one specimen there are but two bristles on posterior edge of abdomen though this is undoubtedly due to injury.

Parasterna I each with seven bristles; parasterna II each with four bristles, the extra one being on the mesal end; I was unable to discern bristles on mesal end of parasterna III and IV because of dense black substance on this area; for bristles of ventral skin see figure 19; all bristles of ventral aspect longer than in the species.

Legs similar to the species but the spines are longer and sharper, the only clavate spine being that of coxæ I, which immediately differentiates the two forms (figures 20 and 24). Moreover the two spines of genuals I are subequal.

This is a more specialized form of the species.

Nymphs: What I take to be nymph III has six bristles to each parasterna I and (very distinctly) four bristles to each genital cover, thus being radically different from the species (figures 29, where the lower parasternum II is abnormal in possessing an extra bristle).

Cotypes: One adult, five nymphs, from heavy, green, foliose lichens on boulders near Erhu Miao, Taishan, Shantung, China; taken July 19 and 25, 1923, slides 2332n1 and 2345.

It may seem remarkable to find the species of the hills of western Shantung closely related to that of the Peking hills while the species of east Shantung is entirely different. This however is in harmony with distributional data of other phylla and warrants the inference that Korea has a species closely related to that of eastern Shantung. Later researches may require placing *C. sinensis* in another genus. The number of dorsal bristles and the agenital plates are much reduced.

In retrospect, the armature of legs I serves as a remarkably constant and easily observed specific (and subspecific) character, but one must be sure to view the leg exactly dorsoventrally or the ventral spines will appear subimposed against the mesal. The development of the cephalic plate and number, position, and development of its bristles are also of great value. The character of the body bristles also differs between species (compare figures 25 to 26 with 2, 3 and 5, and with 11). The pseudostigmata are anterodorsad of the palp insertions and therefore more approximate. The organs are very characteristic of the species and differ widely between species.

PROCAECULUS gen. nov.

Cephalic plate so poorly developed that the pseudostigmata and even the rostrum are visible in dorsal aspect.

Type: *Procaeculus bryani* sp. nov.

Procæculus bryani sp. nov.

(Figures 9-14)

Diagnostic characters: Anterior bristles long, clavate, distal end curved mesad (figure 9); pseudostigmatic organs fairly long, abruptly clavate, the head studded with minute warts (figure 13); bristles of posterior edge of dorsal shield and abdomen, smooth, spoon-shaped (figures 9 and 11); coxæ I with a small, weakly clavate bristle on mesal face; trochanters and femora appear fused in the holotype, the trochanteral bristle shorter, curved, pointed; genuals with two spines and a minute, proximal bristle; claws equal (figure 10); palps with a ciliate, and a clavate bristle (figure 14).

Description: The holotype is too dense to make a detailed description possible.

Holotype: An adult (?) from Peale Island, Wake Island, Western end of the Hawaiian Island group; taken July 21, 1923 by E. H. Bryan on the Tanager Expedition, slide BBMo6T.

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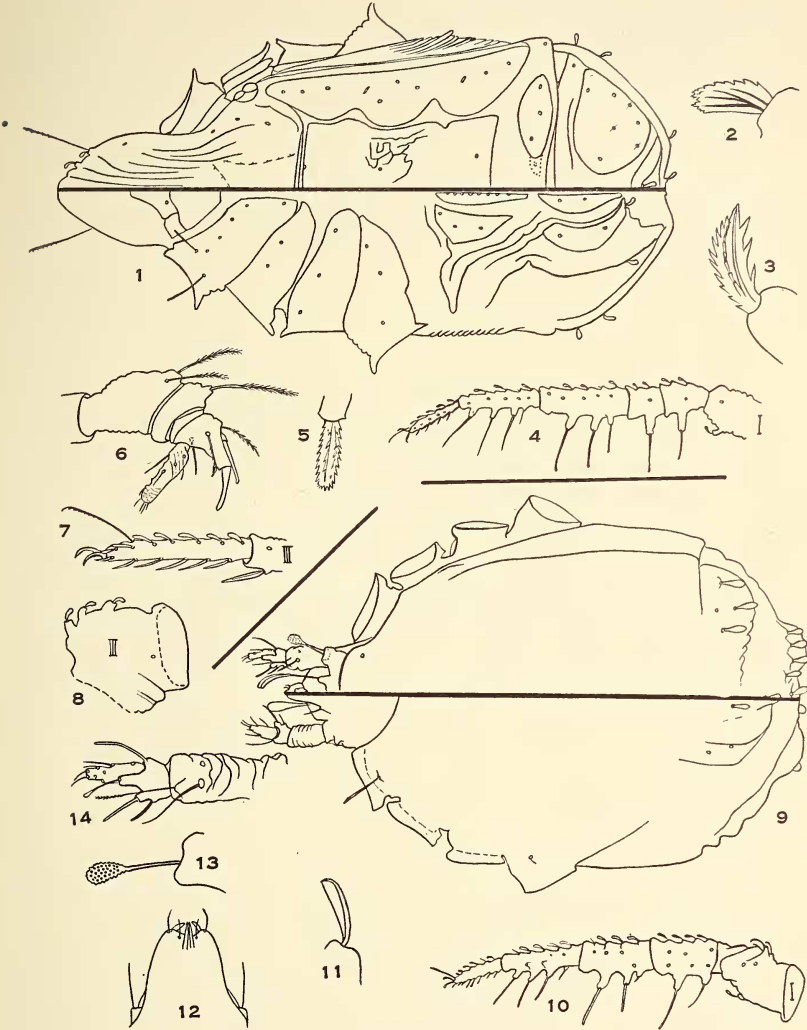
PLATE I

Cæculus echinipes crosbyi subsp. nov., adult

- Figure 1. Dorso/ventral aspects, legs and mouthparts omitted; ratio $\times 60$.
Figure 2. Bristle from edge of cephalic plate; ratio $\times 440$.
Figure 3. Bristle from coxa of legs I; ratio $\times 440$.
Figure 4. Legs I, dorsal aspect; ratio $\times 40$.
Figure 5. Bristle of femur of legs II; ratio $\times 200$.
Figure 6. Palp, lateral aspect; ratio $\times 120$.
Figure 7. Tarsi III; ratio $\times 75$.
Figure 8. Coxal trochanter III; ratio $\times 100$.

Procæculus bryani gen. et sp. nov., nymph III

- Figure 9. Dorso/ventral aspects, legs omitted; ratio $\times 75$.
Figure 10. Legs I, dorsal aspect; ratio $\times 40$.
Figure 11. Bristle from coxa of legs I; ratio $\times 440$.
Figure 12. Mouthparts, ventral aspect; ratio $\times 200$.
Figure 13. Pseudostigmatic organs, dorsal aspect; ratio $\times 150$.
Figure 14. Palp, dorsal aspect; ratio $\times 150$.



CÆCULINÆ

PLATE II

Cæculus loashanensis *sp. nov.*, adult

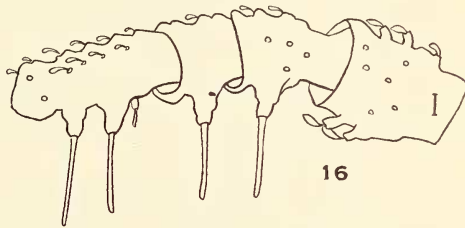
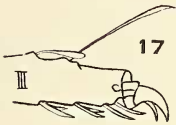
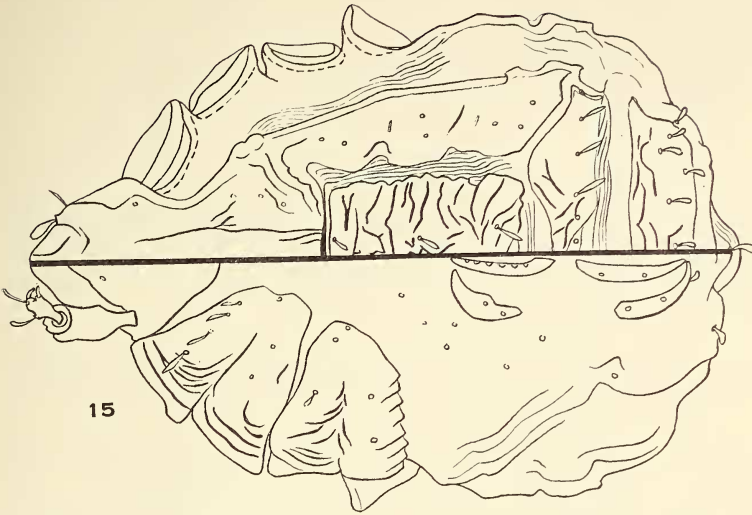
Figure 15. Dorso/ventral aspects, legs omitted; ratio $\times 60$.

Figure 16. Trochanter to genual of legs I; ratio $\times 60$.

Figure 17. Distal end of tarsi III or IV; ratio $\times 60$.

NYMPH I

Figure 18. Ventral aspect, legs II to IV omitted; ratio $\times 60$.



CÆCULINÆ

PLATE III

Cæculus sinensis taishanicus subsp. nov., adult

- Figure 19. Dorso/ventral aspects, mouthparts and legs omitted; ratio $\times 60$.
Figure 20. Legs I, somewhat foreshortened; ratio $\times 40$.
Figure 21. Claws of tarsi I, mesal aspect; ratio $\times 200$.
Figure 22. Claws of tarsi II, ventral aspect; ratio $\times 200$.

Cæculus sinensis sp. nov., adult

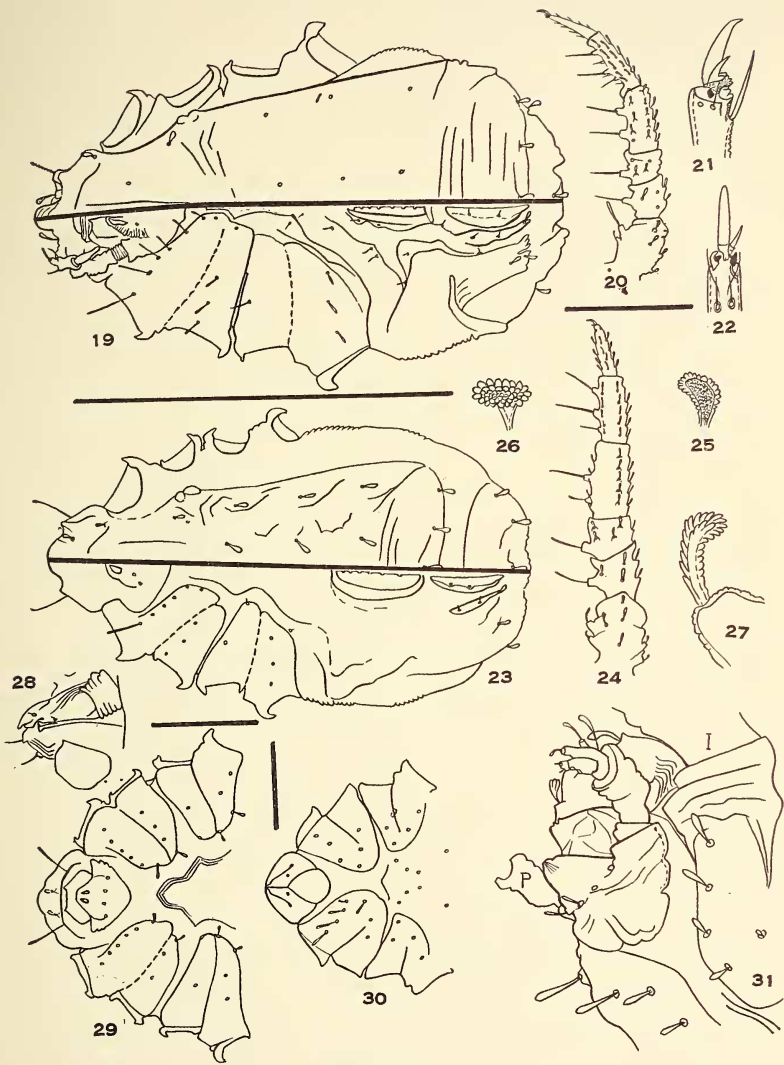
- Figure 23. Dorso/ventral aspects, mouthparts, legs, and minute bristles of venter omitted; ratio $\times 75$.
Figure 24. Legs I, foreshortened; ratio $\times 60$.
Figure 25. Marginal bristle of cephalic plate, oblique aspect; ratio $\times 440$.
Figure 26. Marginal bristle of abdomen, end view; ratio $\times 440$.
Figure 27. Mesal bristle of coxæ I; ratio $\times 440$.
Figure 28. Mouthparts, ventral aspect, showing maxillæ and mandibles above, removed on lower half of figure to show side of camerostome with its two bristles, and attachment rim of palp; ratio $\times 100$.

Cæculus sinensis taishanicus subsp. nov., nymph III

- Figure 29. Ventral aspect of cephaloprothorax, mouthparts and legs omitted; ratio $\times 60$.

Cæculus sinensis subsp. nov., nymph II

- Figure 30. Ventral aspect of cephaloprothorax, mouthparts and legs omitted; ratio $\times 60$.
Figure 31. Mouthparts and parasterna I, ventrolateral aspect; ratio $\times 150$.



CÆCULINÆ